

The Creswellian (Pleistocene) human axial skeletal remains from Gough's Cave (Somerset, England)

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SYNOPSIS. Human axial skeletal elements are described from Pleistocene deposits in Gough's Cave. They include 10 vertebrae and 51 rib fragments belonging to at least three individuals, possibly one male and two females. Some of the ribs show marks made by stone tools, suggesting human damage before they were deposited.

INTRODUCTION

Axial skeletal elements from the Pleistocene deposits of Gough's Cave include 10 vertebral and 51 rib fragments. Some of the vertebrae and ribs are nearly complete, but most are broken and incomplete. A number of ribs also bear cut marks attributable to stone tools (see Andrews & Fernandez-Jalvo, *in litt.*), suggesting some degree of human induced damage and breakage prior to deposition.

The axial remains represent at least three individuals. A number of the preserved vertebrae articulate well, and it is possible that all of the vertebrae recovered derive from a single individual (although one specimen is slightly smaller than the others and may represent a second individual). However, based on the size and morphology of the ribs, most of them derive either from a smaller, possibly female, individual and a larger, possibly male, individual. Six rib fragments, representing ribs from the middle of the series of the left side, appear to represent a third individual. The corresponding ribs in the other two individuals are relatively well represented, so it is unlikely that these six fragments belong to the other two series. The ribs of this third individual are more similar in size and thickness to those of the smaller, more complete individual, and thus they may represent an additional female. Five humeral fragments were recovered from these deposits, a right side humerus from a larger individual and two right and two left side fragments representing smaller individuals, making it probable that the axial remains also sample at least three individuals (note, however, that the overall representation of upper limb remains suggests at least four individuals are represented in the sample).

The vertebral fragments are described first, followed by treatment of the rib remains grouped by individual. Specimens are referred to by their current Natural History Museum designations (M.54###), followed by excavation numbers in parentheses. Comparative vertebral dimensions were drawn from the literature, while for the ribs, comparative data are limited to a small sample of recent European-Americans ($n = 20$, Franciscus & Churchill, *in press*).

VERTEBRAL REMAINS

Inventory

M.54042 (GC 87 134)

This is a largely complete second cervical vertebra (axis) (Fig. 1). There is some damage to the dorsal part of the spinous process and to

the lateral aspects of the transverse processes bilaterally (however, both transverse foramina are intact). Damage to the lateral side includes a part of the right side inferior articular facet (roughly one-half of the facet is preserved). Cut marks abound on the ventral surface from the base of the articular facet on the dens to the inferior edge of the body.

The bone is from a large adult (all secondary centers of ossification are fused and the epiphyseal lines are obliterated). The facets for articulation with the first cervical vertebra are large (with a maximum diameter anterolaterally to posteromedially of 16.2mm). There is some rugosity on the inferior surface of the neural arch at the junction of the right and left laminae, probably representing the attachment of the median thickening of the bands of the ligamentum flavum. Although there is a slight extension of the left side inferior annular ring that may reflect some incipient exostotic growth, there are no clear signs of degenerative changes on any of the articulating surfaces. This specimen articulates well with M.54043.

M.54043 (GC 87 174 & CG 87 226D)

These two fragments conjoin to form a portion of a typical cervical vertebra (Fig. 2). The specimen preserves the corpus and the right side pedicle, inferior and superior articular facets, lamina (almost to midline), and part of the transverse process (lacking the anterior and posterior tubercles and the costotransverse bar – *i.e.*, the anterolateral side of the foramen). There is some damage to the anterior surface of the body. The body is small with well developed uncinat processes superiorly. Based on the preserved portion of the right side lamina, the vertebral foramen was roughly as long anteroposteriorly as it was wide mediolaterally. The pedicle is relatively short, and the superior articular facet is directed superoposteriorly. These features suggest that this element belongs to the superior portion of the cervical series (excluding vertebrae C1 and C2). This specimen articulates well with M.54042 (a second cervical) superiorly and with M.54044 inferiorly (Fig. 3), suggesting that this is a third cervical vertebra and that these three vertebrae represent the same individual.

The pedicles, judging from the preserved right side, were fully fused at the time of death.

M.54044 (GC 87 177)

This is a corpus of a cervical vertebra, with some slight damage to the anterior surface (Fig. 4). The body is slightly larger than that of M.54043 and makes an excellent fit with its inferior surface, and this is most likely to be the subjacent vertebra (C4).

The uncinat processes are well developed. The pedicles are broken away from the centrum and there are no traces of epiphyseal

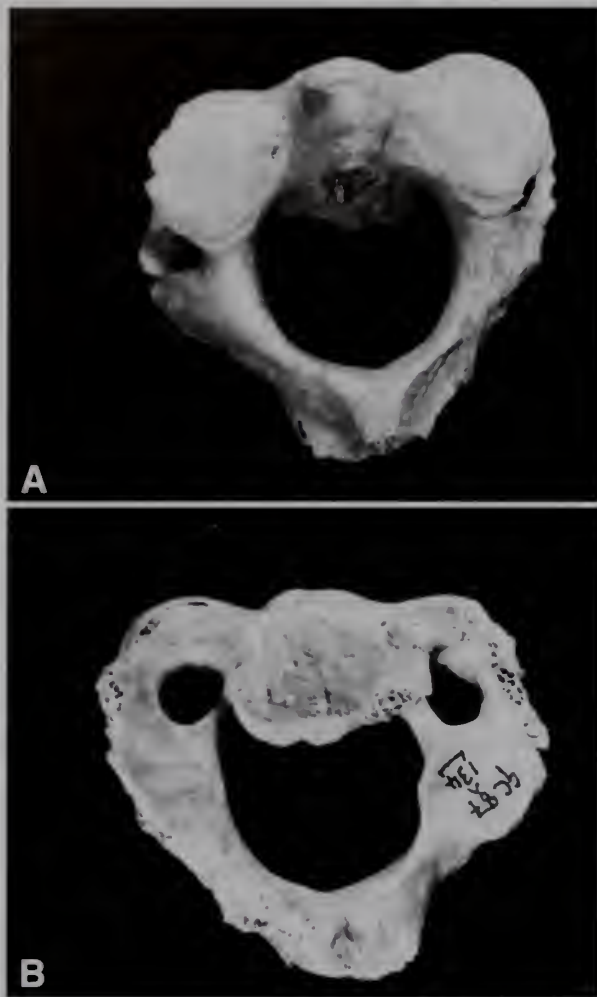


Fig. 1 Second cervical vertebra, M.54042. 1a, superior; 1b, inferior; $\times 1$.

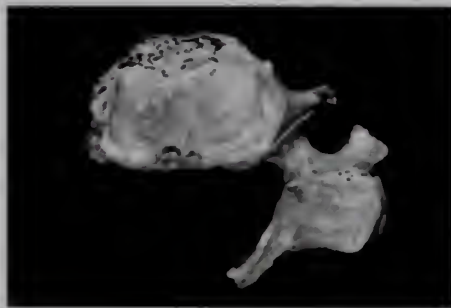


Fig. 2 Cervical vertebra, M.54043, superior, $\times 1$.

surfaces, suggesting that the pedicles were fully fused at the time of death.

M.54045 (GC 87 122 B)

This is a fragment of the left side superior and inferior articular facets of a cervical vertebra, including a small portion of the lamina and pedicle (Fig. 5). The transverse foramen is broken away. Based on the size and orientation of the articular facets this fragment appears to be from a cervical vertebra fairly low in the sequence (C5 or C6). The size of the lamina, pedicle and articular facets is consistent with the size of the other cervical vertebrae described here, thus this fragment probably belongs to the same individual.

M.54046 (GC 87 226 B)

This fragment preserves the body and right side pedicle, superior and inferior facets, and partial lamina of a cervical vertebra (Fig. 6). The costotransverse bars are broken away bilaterally, and the preserved

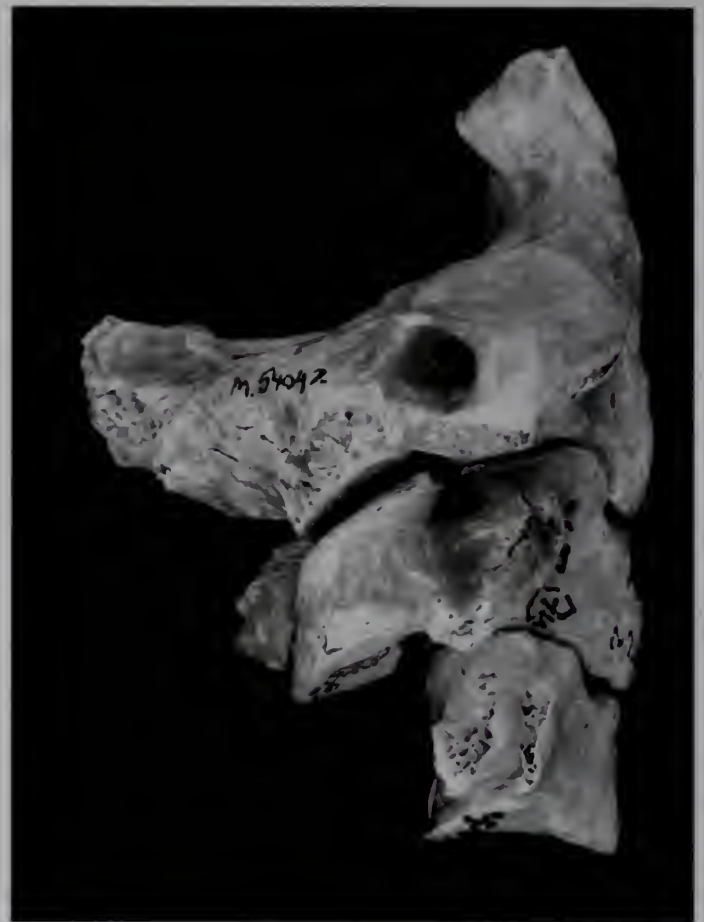


Fig. 3 Cervical vertebrae M.54042 (above), M.54043 (middle) and M.54044 (below) in articulation. Lateral, $\times 1$.

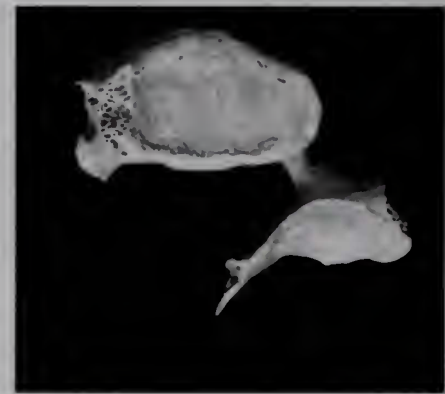


Fig. 4 Cervical vertebra, M.54044, superior, $\times 1$.

right side transverse process lacks the posterior tubercle. Again the overall size is consistent with the other cervical vertebrae recovered and this element probably represents the same individual. The corpus is relatively wide mediolaterally, and the vertebral foramen was clearly wider mediolaterally than it was long anteroposteriorly. These features clearly indicate that the element is from the lower part of the cervical series. This specimen has a relatively flat inferior border to the body, suggesting that it is a C7 (vertebra prominens).

The preserved right side uncinat process (the left side process is damaged) is large and projecting. The superior articular facet faces posteriorly, superiorly and slightly medially. There is no evidence of degenerative changes on any of the adjoining surfaces. The preserved pedicle is fully fused to the centrum.

M.54047 (GC 87 152)

This is a fragment of a right side neural arch from a thoracic vertebra (Fig. 7). The fragment preserves the pedicle and most of the costal

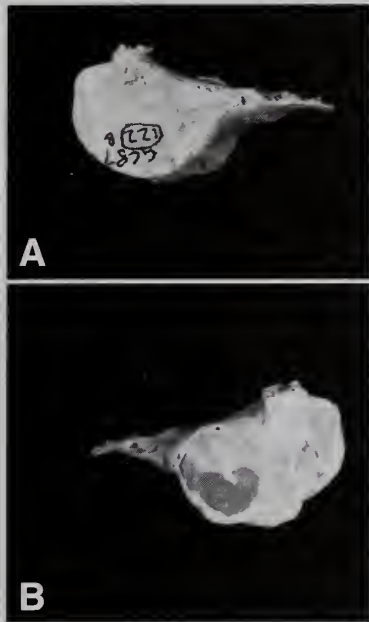


Fig. 5 Left side articular facets of cervical vertebra, M.54045. **5a**, superior; **5b**, inferior; $\times 1$.

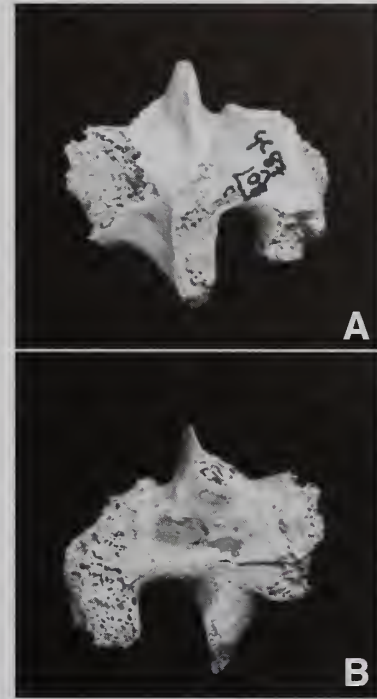


Fig. 8 Thoracic vertebral fragment, M.54048. **8a**, lateral; **8b**, medial; $\times 1$.

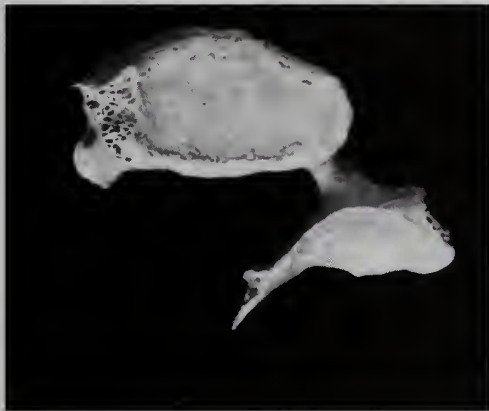


Fig. 6 Cervical vertebra, M.54046, superior, $\times 1$.

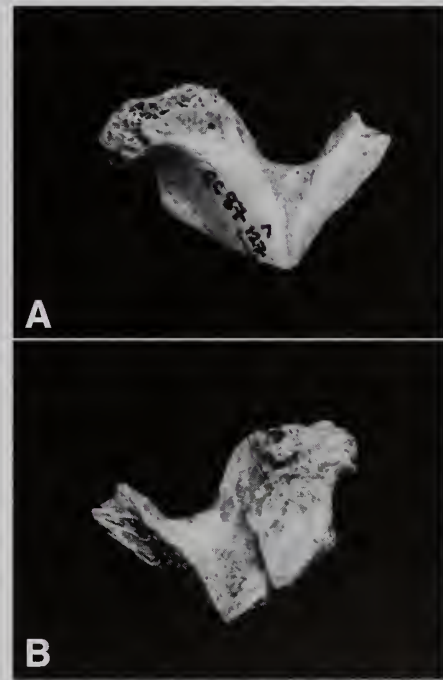


Fig. 9 Thoracic vertebral fragment, M.54049. **9a**, superior; **9b**, inferior; $\times 1$.

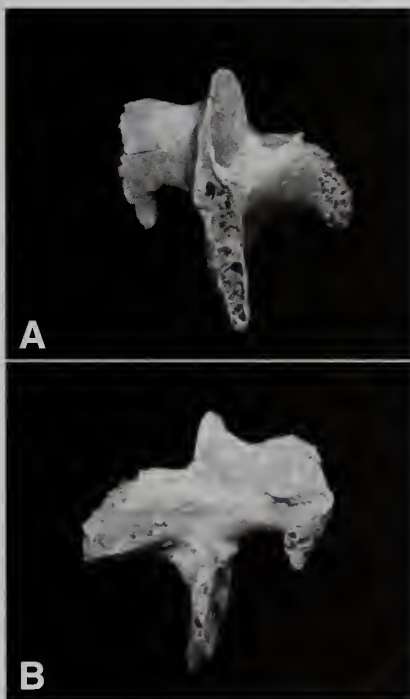


Fig. 7 Thoracic vertebral fragment, M.54047. **7a**, medial; **7b**, lateral; $\times 1$.

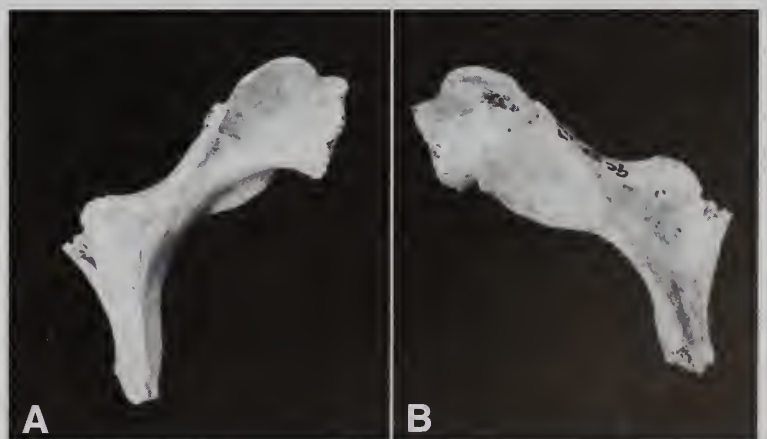


Fig. 10 Thoracic vertebral fragment, M.54050. **10a**, superior; **10b**, inferior; $\times 1$.

Table 1 Dimensions (mm) of the cervical vertebrae.

	M.54042 (C2)	M.54043 (C3)	M.54044 (C4)	M.54046 (C7)
Superior external transverse articular diameter ¹	45.4	–	–	–
Superior internal transverse articular diameter ²	19.1	–	–	–
Superior transverse articular diameter ³	32.3	–	–	–
Inferior internal transverse articular diameter ⁴	20.9	–	–	–
Inferior transverse articular diameter ⁵	(32.2)	–	–	–
Spinal canal dorso-ventral diameter (M-10)	22.9	–	–	–
Spinal canal transverse diameter (M-11)	24.2	–	(22.9)	–
Body ventral height (M-1)	22.3	(11.0)	13.5	13.2
Body dorsal height (M-2)	16.6	12.3	12.8	12.6
Body median height (M-3)	–	11.7	11.7	11.0
Odontoid process height (C2) (M-1a)	14.0	–	–	–
Body superior dorso-ventral diameter (M-4) ⁶	11.7	(13.4)	13.5	14.5
Body superior transverse diameter (M-7)	–	17.4	18.6	(26.4)
Body inferior dorso-ventral diameter (M-5)	16.4	15.8	14.7	15.8
Body inferior transverse diameter (M-6)	18.6	19.4	20.2	25.9

1. Maximum distance between the lateral edges of the superior articular facets.

2. Maximum distance between the medial edges of the superior articular facets.

3. Average of the external and internal transverse articular diameters of the superior articular facets.

4. Maximum distance between the medial edges of the inferior articular facets.

5. Distance between the (estimated) midpoints of the inferior articular facets.

6. For the C2, measurement was taken in the transverse plane defined by the medial edges of the superior articular facets.

Table 2 Dimensions (mm) of the second cervical vertebrae.

Specimen	VBH ¹	SCTD ¹	SCDVD ¹	OPH ¹	Reference
Gough's Cave Creswellian	22.3	24.2	22.9	14.0	
Chancelade 1 (♂)	(26) ²	–	–	13	Billy, 1969
Predmostí 3 (♂)	19.0	25.5	18.0	12.0	Matiegka, 1938
Predmostí 4 (♀)	16.5	22.4	18.0	10.8	Matiegka, 1938
Predmostí 9 (♂)	–	22.0	15.0	12.5	Matiegka, 1938
Predmostí 14 (♂)	19.5	24.6	16.5	13.3	Matiegka, 1938
Skhul V (♂)	18.0	26.0	24.6	12.5	McCown & Keith, 1939; Stewart, 1962
Fossil mean ³	19.8	24.1	18.4	12.4	
SD, (n)	3.7 (5)	1.8 (5)	3.7 (5)	0.9 (6)	
European-American males (n = ±96) ⁴	–	24.1	17.1	–	Lanier, 1939
African-American males (n = ±88) ⁴	–	23.9	16.2	–	Lanier, 1939

1. VBH = ventral body height (M-1); SCTD = spinal canal transverse diameter (M-11); SCDVD = spinal canal dorsoventral diameter (M-10); OPH = odontoid process height (M-1a).

2. Taken as [total anterior height] – [odontoid process height] from reported values.

3. Mean of fossils (sexes combined) excluding the Gough's Cave Creswellian material.

4. Mean value, no standard deviation reported.

facet of the body, the superior and inferior articular processes, a very small bit of the lamina, and a portion of the transverse process (none of the costal facet of the transverse process is present) with a very small portion of the inferior tubercle. Judging from the small size of the articular facets, the fragment probably comes from a thoracic vertebrae fairly high in the sequence (T1–5). The articular facet on the body looks large relative to the pedicle (larger than the demi-facets usually seen on thoracic vertebrae), so this fragment may represent the first thoracic vertebra. However, the superior articular facet makes a poor fit with the inferior facet of the possible seventh cervical vertebra M.54046 (which may not, however, represent the same individual).

This specimen has a large cutmark across the base of the transverse process, but based on coloration it looks to have been recently imposed, possibly during excavation or preparation. The right side pedicle is fully fused with the centrum, suggesting that this bone derived from an adult.

M.54048 (GC 87 108 C [1014.0])

This is a small fragment representing a portion of the right side dorsolateral body of a thoracic vertebra, with the right pedicle,

superior and inferior articular facets, and a small bit of the transverse process and lamina (Fig. 8). A small portion of the superior surface of the vertebra is preserved. The demi-facet for the rib head is not preserved, but that this bone represents a thoracic vertebra is clear given the size of the pedicle and the orientations of the articular processes (Bass, 1987). In thoracic vertebrae, the position of the superior demi-facets on the corpi migrates dorsally going from T1 to T12 (personal observation). Generally by the middle of the thoracic series the demi-facet is partially or wholly on the pedicle. There is no sign of the demi-facet on the lateral surface of the pedicle in this specimen, and this, combined with the overall morphology of the articular process, suggests it is from the higher part of the sequence (likely T1–T5). The right side pedicle is fully fused to the body.

M.54049 (GC 87 127)

This is a neural arch fragment from a thoracic vertebra, preserving most of the left lamina, including the inferior articular facet and the base of the transverse tubercle, and a small portion of the right lamina (Fig. 9). The neural arch is small relative to the other vertebrae recovered, and may represent another, perhaps subadult or female, individual.

Table 3 Anterior and posterior body heights (mm) of cervical vertebrae.

Specimen		C3	C4	C5	C6	C7	Reference
Gough's Cave Creswellian	ant	(11.0)	13.5	—	—	13.2	
	post	12.3	12.8	—	—	12.6	
Gough's Cave 1 (Cheddar Man) (♂)	ant	—	—	—	(12.2)		
Chancelade 1 (♂)	ant	12	—	12.5	13	13	Billy, 1969
	post	14.5	—	15.5	15	15	
Oberkassel 2 (♀)	ant	12	—	—	—	—	Billy, 1969
	post	13	—	—	—	—	
Arene Candide 2 (♂)	ant	11	11	12	12	14	Paoli <i>et al.</i> , 1980
	post	13	14	13	13	15	
Arene Candide 3 (♀)	ant	—	—	—	12	14	Paoli <i>et al.</i> , 1980
	post	—	—	—	14	14	
Arene Candide 10 (♂)	ant	—	—	—	—	(13)	Paoli <i>et al.</i> , 1980
	post	—	—	—	—	(13)	
Arene Candide 12 (♂)	ant	—	10	—	12	—	Paoli <i>et al.</i> , 1980
	post	—	12	—	12	—	
Abri Pataud (♀)	ant	12.5	—	—	—	—	Billy, 1969
	post	13	—	—	—	—	
Predmostí 3 (♂)	ant	11.3	(12)	12.0	11.0	13.0	Matiegka, 1938
	post	12.6	12.7	14.0	13.4	14.5	
Predmostí 9 (♂)	ant	—	—	12.4	11.6	13.0	Matiegka, 1938
	post	—	12.8	13.0	14.0	14.0	
Predmostí 14 (♂)	ant	13.0	12.2	12.0	11.8	—	Matiegka, 1938
	post	13.0	13.0	15.0	15.5	16.0	
Skhul V (♂)	ant	—	8.5	9.5	(10)	—	McCown & Keith, 1939; Stewart, 1962
	post	10.5	9.5	10.5	(13)	(12.5)	
Fossil males ¹ , mean SD, (n)	ant	11.8	10.7	11.7	11.7	13.2	
		0.9 (4)	1.5 (5)	1.1 (6)	0.9 (8)	0.4 (5)	
	post	12.7	12.3	13.5	13.7	14.3	
Fossil females ¹ , mean SD, (n)	ant	12.3	—	—	12	13	
		0.4(2)	—	—	(1)	(1)	
	post	13.0	—	—	14	13	
European-American males (n = ±96) ²	ant	14.1	13.5	12.7	12.7	14.4	Lanier, 1939
	post	14.0	13.7	13.7	13.6	15.0	
African-American males (n = ±88) ²	ant	13.3	12.8	12.1	11.9	13.8	Lanier, 1939
	post	13.4	12.8	12.6	12.7	14.0	

1. Fossil mean, excluding the Gough's Cave Creswellian material.
 2. Mean value, no standard deviation reported.

M.54050 (GC 87 127 A)

This is a fragment of neural arch of a thoracic vertebra. The fragment preserves the right lamina, including the superior and inferior facets and the base of the transverse process, and most of the spine (Fig. 10). It is clearly from a larger individual than that represented by M.54049.

The superior facet rounds down onto the superior surface of the root of the transverse process. The inferior facet rounds dorsally along its inferior margin, producing an inferiorly facing 'lip' on the facet. Based on the shape of the facets and overall morphology of the fragment, this appears to represent a vertebra from somewhere in the middle of the thoracic column.

Morphology

The fragmentary nature of the vertebrae from the late Pleistocene deposits at Gough's Cave make it difficult to reach any conclusions about their morphology. Of the ten vertebral fragments recovered, nine may represent the same individual. The tenth, M.54049, appears to derive from a smaller, perhaps female or subadult (although the two lamina of the neural arch are fully fused together) individual. Because of the fragmentary state of these remains, few osteometric observations could be made (Table 1).

Comparative data taken from the literature is provided in Tables 2

and 3. The comparative samples of European Upper Paleolithic fossils are admittedly small, especially with respect to female specimens. In terms of cervical vertebral body heights, M.54043, tentatively attributed to a C3, is small in both ventral and dorsal body heights relative to males and females of comparable geological age (Table 3). However, M.54044, attributed to a C4, has body heights higher than the small sample of Upper Paleolithic males presented in Table 3. M.54046, a possible C7, has a ventral body height equal to the mean value of five Upper Paleolithic males (and very close to the dimension obtained for a single female), but has a dorsal body height more than one standard deviation below the Upper Paleolithic male mean (but very close to the value obtained for the single female) (Table 3). In all the cervical vertebrae in which body heights could be determined, the dimensions from the Gough's Cave sample are smaller than the mean values obtained by Lanier (1939) on a sample of ± 96 European-American skeletons. While it is not possible to make reasonable inferences about the sex of the individual represented by these remains, it is possible to conclude that this individual was small by Paleolithic and modern standards. This is also reflected in dimensions of the spinal canals and the odontoid processes of the C2 (Table 2). Given that a single fragment, M.54049, may represent an individual who was smaller still, this sample seems to represent a relatively small body-sized population.

COSTAL REMAINS

Introduction

As noted above, most of the ribs from the Pleistocene deposits of Gough's Cave can be confidently attributed to one of two individuals. Six rib fragments (representing three ribs) that do not appear to fit with the other two individuals (on the basis of curvature and posterior angle morphology) indicate the presence of a third individual.

The first individual was the smaller, and had lightly constructed ribs (Fig. 11; Table 4). These ribs tend to have proximal bodies that are square or rectangular in section with wide, inferiorly directed subcostal grooves (generally extending proximally to the tubercle). The subcostal grooves are formed by the flat inferior surface of the rib internally and a crest for *M. iliocostalis* and/or the external intercostal muscle externally. The reassociation of most of the ribs of this individual was based on similarities in 1) size, 2) curvature, and 3) the morphology of the *M. iliocostalis* line (the *M. iliocostalis* line is superoinferiorly compressed in this individual and runs almost horizontally (proximodistally) along the rib). The right-side eleventh rib was attributed to this individual based on its curvature (it is too curved to fit with the ribs of the second individual) and small size. The right and left twelfth ribs were attributed to this individual based on the similarity in superoinferior diameter between them and the right eleventh rib. The heads of all but one rib are missing from this individual, raising the possibility that they were unfused (the smaller size and fragility of these ribs would fit with their deriving from a subadult individual). However, the proximal surfaces are all either covered in matrix or too damaged to evaluate the state of fusion of the heads. The one rib preserving the articular surface of the head (the right 11th rib, M.54014) retains a portion of the actual articular surface. In this rib the head appears to be fused, but the epiphyseal line may not be entirely obliterated. Other possibilities for the lack of

recovery of the vertebral ends of the ribs include breakage at the time of disarticulation from the vertebrae, or post-mortem damage. However, eight of the ten identifiable ribs preserve a substantial amount of the neck proximal of the tubercle, and three preserve the base of the head, so it seems unlikely that post-mortem damage would so uniformly damage the heads but not the necks. Thus it seems likely that the heads were not fused to the costae in this individual.

The second individual is larger and more robust (Table 5; Fig. 12). The ribs are thick mediolaterally and are more heavily muscle marked. The proximal shafts tend to be more rounded in section, and the subcostal groove tends to be more internally directed and, in a number of the ribs, does not extend proximally much beyond the posterior angle. Reassociation of the ribs of this individual was based on similarities in 1) size and curvature, 2) mediolateral thickness of the corpi, 3) *M. iliocostalis* line morphology (the line is more vertically oriented in this individual, and the ribs are superoinferiorly broader at the posterior angle so that the *M. iliocostalis* attachment area does not form a 'tubercle' as it does in the first individual), and 4) subcostal groove morphology. The ribs tend to be broken proximally between the posterior angle and the tubercle. Of fifteen fragments clearly attributable to this individual, only two preserve the tubercle (one of these being a proximal fragment that also preserves the head), and an additional one has a tiny portion of the tubercle preserved. The single fragment preserving the head shows a fully fused articular surface, indicating that this individual was likely greater than 20 years old at death (Williams & Warwick, 1980). The ribs of this individual tend to be more heavily cutmarked than those of the smaller individual.

Three ribs do not seem to fit, on the basis of size, curvature and *M. iliocostalis* line morphology, with these other two individuals. These are all left side ribs, and two of them are very similar in morphology and appear to be adjacent ribs (Fig. 13). The third is thicker mediolaterally, but matches the other two in overall curvature. This larger, thicker rib may represent one of the lower typical ribs, so the difference in mediolateral thickness might reflect variation along the series (or perhaps the rib belongs to yet another individual). For the time being these three ribs will be considered as a third individual.

Individual ribs were identified as to side and number using overall size and shape, the position of the *M. iliocostalis* line, and the size and shape of the articular facets. Sequencing the ribs was facilitated by comparisons of the fossil specimens to sequenced ribs from recent human skeletons from the collections of the Natural History Museum. Sequencing of the complete series from the modern comparative skeletons was based on criteria outlined in Dudar (1993), Jellema *et al.* (1993), Mann (1993), and Franciscus & Churchill (in press). After identifying each fossil rib based on its diagnostic morphological features and comparison with the sequenced recent human series, the two sets of fossil ribs were sorted on the basis of size and morphology, and then laid out in sequence. This allowed for the refinement of earlier assessments by comparing aspects of *M. iliocostalis* placement, the relative height of the rib heads in the sagittal plane (Mann, 1993), and size and curvature from rib to rib.

Metric observations of the ribs are recorded in Tables 6–9.

Table 4 Ribs attributed to Individual 1.

Rib	Left	Right
1	M.54001	–
2	M.54002	M.54009
3	M.54003	–
4	M.54004	M.54010
5	M.54005	M.54011
6	M.54006	M.54012
7–9	M.54007	M.54013
11	–	M.54014
12	M.54008	M.54015

Table 5 Ribs attributed to Individual 2.

Rib	Left	Right
1	M.54016	–
2	M.54017	M.54026
3	M.54018	M.54027
4	M.54019	M.54028
5	M.54020	M.54029
6	M.54021	M.54030
7	M.54022	–
6–9 (right)	–	M.54031
8–9 (left)	M.54023	–
	M.54024	–
	M.54025	–
10	–	M.54032

INVENTORY

Individual 1

RIB 1

Left: M.54001 (GC 87 56)

The left first rib is represented by a single fragment (Fig. 11). The fragment lacks only the head and portions of the sternal end, and is



Fig. 11 Ribs of individual 1, superior, $\times 0.5$.

also missing a piece of bone roughly 25mm in length along the distal external edge. The straight line distance from the ventral-most margin of the articular tubercle to the ventral-most point of the sternal end of the rib (McCown & Keith, 1939: fig. 75) is roughly 72mm, while the maximum subtense from this line to the lateral-most extent of the rib shaft (*ibid.*) is ca. 25mm. Abundant cutmarks can be seen on the superior surface in the region of the proximal attachment area for *M. scalenus medius* (the cutmarks extend along the internal edge from the neck to the level of the distal tubercle). Cutmarks can also be seen on the superior proximal and distal sides of the tubercle, which may reflect cutting of the lateral costotransverse ligament. There is some slight weathering to the distal superior surface of the shaft.

The ligamentous part of the tuberosity is neither rugose nor large. The crest for *M. scalenus medius* along the superior proximal surface of the shaft is insignificant and non-rugose. There is a small crest on the external edge of the rib distal of the tubercle that may represent the lateral limit of this muscle. There are no other visible muscle markings on the bone. There is no perceptible scalene tubercle, so the grooves for the subclavian artery/1st thoracic nerve and subclavian vein run together into one shallow, poorly delimited sulcus.

RIB 2

Right: M.54009 (GC 87 220)

Left: M.54002 (GC 87 132)

Both second ribs are represented by fragments. The right second rib

preserves a part of the head, the tubercle and the proximal shaft up to but not including the attachment area for *M. serratus posterior superior* (and extending further on the internal side). The total length of this fragment is 62.3mm. Most of the head is missing or eroded. The partial preservation of the head allows for a rough estimate of neck length (the distance from the middle of the head to the middle of the articular tubercle) of ca. 24mm. Cutmarks are visible on the neck (especially on the inferior neck surface) and on the nonarticular tubercle. The left 2nd rib is represented by a proximal fragment. The rib is completely preserved from the neck to the proximal end of the *M. scalenus posterior* crest, after which only the internal edge is preserved for another 42mm. The total length of the fragment is 70.4mm.

The articular facets are relatively large for a second rib (measuring 9.8mm proximodistally by 7.8mm superolateral-inferomedial on the right; 9.5mm PD by 7.7mm SL-IM on the left). The nonarticular tubercles do not present themselves as single tubercles immediately adjacent to the articular facets, but instead as a series of two or three rugose ridges running superoproximally to inferodistally. On the left-side rib, the nonarticular tubercle extends along the external inferior margin as a crest for the attachment of the intercostal muscles and membranes.

The proximal end of the *M. serratus posterior superior* tuberosity is visible on the superior lateral surface of the right-side rib. The left-side preserves the proximal and distal portions of the *M. scalenus*

Table 6 Dimensions (mm) of the ribs of Individual One.

Rib	Prox. thick. ¹	Prox. height ²	Shaft thick ³	Shaft height ⁴
LI	16.2	3.9	–	–
RII	12.6	6.6	–	–
LII	12.6	6.1	–	–
LIII	6.5	9.4	5.7	10.0
LIV	7.9	7.5	8.0	8.9
LV	8.2	(8.1)	10.6	6.1
RVI	8.0	9.9	10.9	(11.7)
LV1	–	–	10.9	9.1
RXI	4.7 ⁵	8.7 ⁵	5.4	11.2

1. Proximal thickness (internal-external diameter of rib body just distal of the tubercle) [M-2].

2. Proximal height (superoinferior diameter of rib body just distal of the tubercle) [M-1].

3. Shaft thickness (internal-external diameter of rib body at posterior angle).

4. Shaft height (superoinferior diameter of rib body at posterior angle).

5. Taken just distal of head.

posterior crest. This crest appears to have been very large, with a deep adjacent intercostal sulcus. At the proximal extent of the crest, the body of the rib has a superoinferior diameter of 8.2mm, and the sulcus is 4.1mm deep. The distal end of the crest can be seen on the preserved portion of the internal edge fragment. This provides a minimum proximodistal length of 34.7mm for the *M. scalenus posterior* attachment. The *M. levator costae* insertion areas are preserved bilaterally and are only mildly rugose. The preserved attachment areas for the intercostal muscles and membranes on the interior edges of the superior surfaces are moderately rugose.

RIB 3

Left: M.54003 (GC 87 213)

Only the left third rib is preserved (Fig. 11). This rib is represented by a fragment 100.4mm in total length, complete from just distal of the head proximally to somewhere near mid-shaft distally.

The articular facet measures 8.8mm proximodistally by 6.4mm superoinferiorly. The rib has a very marked *Mm. intercostales* sulcus on its superior margin, formed in part by a relatively large *M. serratus anterior* crest on the superolateral surface of the rib. The rib also has a weakly developed non-articular tubercle, and a subcostal sulcus that is very large and extends proximally past the articular tubercle.

Torsion in the body of the rib (such that a cross-section of the body at mid-shaft would have its long axis running from superointernal to inferoexternal), as well as other aspects of overall morphology, is consistent with this being a third rib.

RIB 4

Right: M.54010 (GC 87 148 & 114B & 114C)

Left: M.54004 (GC 87 94)

The fourth ribs are both present (Fig. 11). The right rib was reconstructed from three fragments. The rejoined fragments produce a proximal rib fragment about 167mm in total length, preserving a portion of the neck proximally, the articular and non-articular tubercles, and the body to around midshaft. The left fourth rib is represented by a proximal fragment with a total length of 111.3mm. The articular surfaces of the head are missing, but the rest of the head, neck and articular and nonarticular tubercle are complete. The preserved portion of the head allows for a very rough estimate (since the articular surfaces are missing) of neck length (see above) of ca. 22mm. The shaft is complete internally to about midshaft. The external surface is complete to about 35mm distal of the posterior angle, after which trabeculae are exposed. A few cutmarks can be seen on the internal surface of the neck of the right side rib.

The superior edge of the neck of the left rib continues distally as

a very weak crest for the superior costotransverse ligament. This crest becomes distinct at its merger with the attachment of the *M. intercostales externi* and the *M. iliocostalis* line. In the left rib, the *Mm. intercostales* form a distinct yet shallow sulcus along the superior edge. The articular facets are relatively small, measuring 9.9mm (proximodistally) by 8.1mm (mediolaterally) on the right and 9.7mm (PD) by 8.1mm (ML) on the left, and are very slightly curved. On the right side, the shallow subcostal groove begins at the articular facet. On the inferior edge of the left side rib the subcostal groove is very poorly developed and is hardly discernible. In this rib there is a very small flange where the *M. iliocostalis* line crosses the inferior margin.

RIB 5

Right: M.54011 (GC 87 265 & 89 013)

Left: M.54005 (GC 87 34 & 48)

The right fifth rib has been reconstructed from two fragments. Together they comprise the proximal half of the rib, preserved from just proximal of the articular tubercle to somewhere below midshaft distally (Fig. 11). Much of the rib body is covered in matrix, and distally the internal and external surfaces have split apart and filled with matrix. The exposed surfaces are slightly weathered. The total length of the rejoined fragment is ca. 194mm. The left fifth rib was reconstructed from three fragments (two bearing the same field designation, GC 87 48). This is a virtually complete rib, about 167mm in length. Proximally the head is missing its articular surface, and distally a small bit of the sternal end is lacking. A very rough estimate of neck length (see above) of ca. 24mm can be obtained from the preserved portions. Although the specimen is missing a small portion of the sternal end, it is possible to estimate the straight line distance from the ventral-most rim of the articular tubercle to the ventral-most point of the body (McCown & Keith, 1939: fig. 75) at 177mm, and the maximum subtense from that line to the external-most point on the shaft (*ibid.*) as 58mm. The bone has adherent matrix and small rocks, and the exposed surfaces are weathered. Large cutmarks are visible on the sternal end of the left side rib.

As in the fourth ribs, the articular tubercles are relatively small (9.5mm proximodistally by 8.0mm mediolaterally on both sides). The non-articular tubercles are not very pronounced. In the left rib, the superior edge of the neck continues distally as a raised crest for the superior costotransverse ligament and the *M. levator costae*. This ridge passes laterally of the proximal attachment area of the *Mm. intercostales*, the two ridges together forming a distinct sulcus proximal of the posterior angle. The *M. levator costae* crest continues distally to the angle and merges with the *M. iliocostalis* line. The *M. iliocostalis* scar is relatively small in the left side and is virtually horizontal. The morphology of the *M. iliocostalis* line cannot be determined on the right side rib because of overlain matrix, but the subcostal groove is relatively large and there is a small flange on the inferior rib margin in the region of the iliocostal line. The subcostal grooves are not strongly developed. The ribs are relatively thick, and in the left rib a distinct yet shallow sulcus can be seen on the superior edge marking the attachment of the intercostal muscles.

RIB 6

Right: M.54012 (GC 87 134A)

Left: M.54006 (GC 89 004 & 008)

The right sixth rib is represented by a 64.3mm long fragment, and is preserved from the neck just proximal of the tubercle to the shaft just distal of the posterior angle (Fig. 11). The bone is weathered over its entire surface and has cutmarks on its external surface distal to the posterior angle. The left side rib has been reconstructed from two fragments. The reconstructed rib has a total length of 229mm and is

preserved from the neck to the region of the anterior angle. The proximal end up to and including the articular tubercle is buried in matrix. Most of the external surface is damaged and there is matrix adherent to much of the bone.

In the right rib the articular tubercle is concave proximodistally and is oriented dorsally. It measures 8.3mm (PD) by 8.6mm (SI). The *M. iliocostalis* lines are not well marked. The shafts are rectangular in section, with very mediolaterally broad subcostal grooves.

RIBS 7–9

Right: M.54013 (GC 87 125A)

Left: M.54007 (GC 87 165A)

Two fragments (Fig. 11), one from a right and one from a left side rib, could not be securely identified as to number. Based on size and morphology, they most likely represent ribs in the series seven through nine. By the same criteria, these ribs most likely are associated with the other ribs of Individual One.

The first of these fragments, M.54013, comes from a right rib. The fragment is 99.9mm long and represents the body of a typical rib. The preserved portion derives from somewhere between the posterior and anterior angles. The weathered internal and external surfaces have become separated and infilled with matrix. Besides a portion of the subcostal groove, no landmarks or muscle attachment scars are visible. The preserved portion of subcostal groove is narrow superoinferiorly (ca. 2.5mm SI), and the 'roof' is at an angle of ca. 120°–130° to the internal surface.

The second fragment, M.54007, is 49.7mm long and derives from the mid-distal end of a left typical rib. What appears to be a line for the external oblique muscle, marking the anterior angle, is visible on the external surface. The fragment has a mediolateral diameter of 5.2mm and superoinferior diameter of 12.8mm at the anterior angle.

RIB 11

Right: M.54014 (GC 87 207)

Only the right side eleventh rib is preserved (Fig. 11). This is a virtually complete rib, missing only some sections of the distal shaft external surface. The sternal end is missing, but based on the tapering of the corpus it appears that the bone is broken very close to the distal end. The total length of the fragment is 121.8mm. The overall preservation of the element is very good, and several cutmarks are visible on the external surface of the neck and on the distal external surface.

Only a portion of the proximal articular surface is preserved. The secondary center of ossification appears to be fused to the neck, but it is not clear if the epiphyseal line was closed. There is no articular nor non-articular tubercle, and only a slight development of the subcostal groove. There are very clearly marked and moderately rugose attachment areas for the *Mm. intercostales* on the inferior (a 22.5mm long scar at about midshaft) and superior (a much longer rugose sulcus from midshaft running distally) edges.

RIB 12

Right: M.54015 (GC 87 257)

Left: M.54008 (GC 87 21)

Both twelfth ribs are preserved (Fig. 11). The right side rib is represented by a fragment with a length of 51.6mm. The fragment is preserved from somewhere proximal of midshaft to the area of the anterior angle (preserving a portion of the shaft where it tapers distally). The bone is slightly weathered on its superior external surface. The left twelfth rib is represented by a 75.9mm fragment preserving most of the distal end, from around mid-shaft proximally to just proximal of the distal tip (the distal end is slightly eroded, but the tapering end that marks this as a 12th rib is clearly evident).

In the right side rib, there is a slight rugosity in the area of the *M.*

intercostale externi attachment, and there is a pronounced tubercle at the *M. serratus posterior inferior* insertion. The left rib exhibits a sulcus for *M. intercostale interni* on the superior margin of the intercostal surface. This rib also shows rugose but small crests that form small sulci on the inferior margin, marking the attachment of *M. erector spinae* (on the external surface) and *M. quadratus lumborum* (on the internal surface). Although their attachment areas are preserved, the left rib does not have visible attachment areas for the diaphragm or *Mm. latissimus dorsi* and *externus obliquus*. Both ribs display small, roughened 'tubercles' marking the *M. serratus posterior inferior* insertions along the inferior margins at the anterior angles.

The right side rib is somewhat smaller than its antimere. At the anterior angle, the right rib has a superoinferior diameter of 10.2mm and a mediolateral diameter of 4.2mm, while the left has an SI diameter of 12.7mm and an ML diameter of 4.5mm. However, the two are similar in the morphology of the *M. serratus posterior inferior* insertion scars (it is uncommon to see any visible rugosity in this region in recent human twelfth ribs, thus the similar development of this muscle in both ribs supports their identification as antimeres).

Individual 2

RIB 1

Left: M.54016 (GC 87 217)

Only the left first rib is preserved (Fig. 12). The fragment is 45.1mm long and has a mediolateral width of 21.0mm. The fragment preserves portions of the superior and inferior surfaces and the convex external edge. The superior margin is relatively smooth and preserves the distal portion of the *M. scalenus medius* tubercle. Numerous cutmarks can be observed on the superior surface along the external edge.

RIB 2

Right: M.54026 (GC 86 212)

Left: M.54017 (GC 86 26)

Fragments of both second ribs were recovered (Fig. 12). M.54026 is a section of a right second rib, preserved from the region of the posterior angle proximally to just ventral of the *M. scalenus posterior* crest distally. The fragment has a maximum anteroposterior length of 65.2mm. The fragment preserves all surfaces, but more of the internal margin of the bone is preserved than is the external margin. M.54017 is a fragment of a left 2nd rib, very similar in preservation to its antimere. The left rib is preserved from the region of the posterior angle proximally to a few centimeters distal of

Table 7 Dimensions (mm) of the ribs of Individual Two.

Rib	Prox. thick. ¹	Prox. height ²	Shaft thick ³	Shaft height ⁴
RII	(14.4)	(7.1)	–	–
LII	13.7	7.1	–	–
RIII	–	–	9.4	13.9
LIII	8.3	9.6	9.3	12.0
RIV	8.4	9.3	10.2	13.9
LIV	–	–	8.0	14.6
RV	–	–	10.3	15.7
LV	9.7	(9.8)	10.1	(17.2)
LVI	8.4	9.0	8.7	18.8
LVII	8.2	9.9	8.3	18.2
RVI–IX	–	(11.5)	–	–
LIX?	8.1	10.5	–	–
RX	–	–	7.7	15.6

1–4. See notes in Table 6

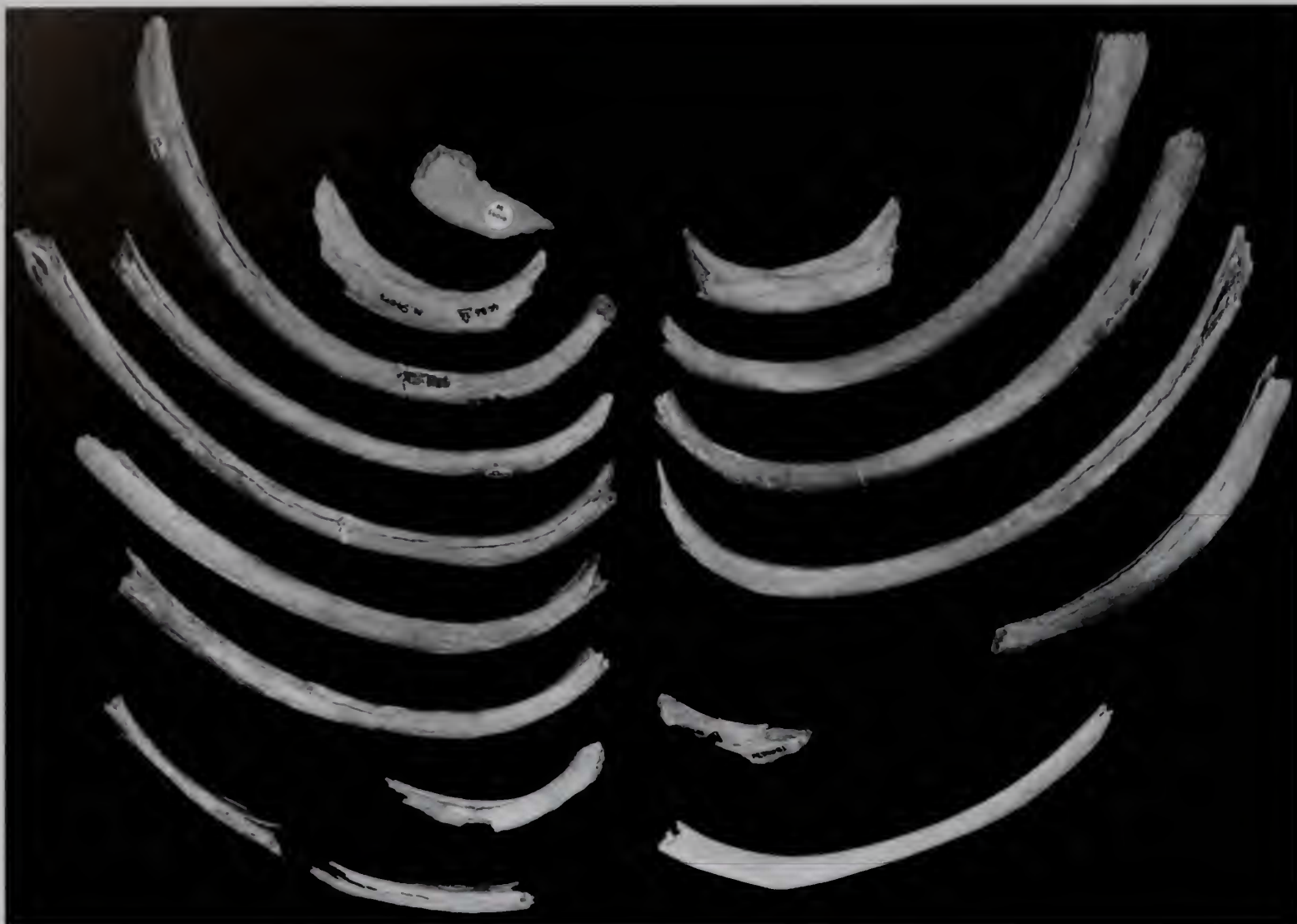


Fig. 12 Ribs of individual 2, superior, $\times 0.45$.

M. scalenus posterior crest distally. The maximum length of the fragment is 73.5mm.

Both ribs are stout with well defined muscle markings. The strength of these ribs is illustrated by their mediolateral diameters at the distal-most point on the *M. scalenus posterior* crest, which measure 17.2mm and 17.5mm in the right and left sides, respectively. The *M. scalenus posterior* crests are very clear and prominent in both ribs, with deep sulci medially for the attachment of the intercostal muscles and membranes. At their points of maximum development the *M. scalenus posterior* crests project 3.3mm in the right rib and 3.2mm in the left (taken as the difference between the superoinferior diameters of the rib on the muscle crest and in the adjacent sulcus). Given that this muscle often leaves no discernible crest in recent human second ribs, this indicates marked muscularity of the upper thorax of this individual. These crest are 34.6mm (right) and 27.6mm (left) in length proximodistally. In the right rib, there is some rugosity visible in the area of the *M. levator costae* attachment, but none in the area of the *M. serratus posterior superior* attachment. On the left side rib, neither of these muscles left discernible scars. In both ribs there are distinct crests on the inferior proximolateral surface marking the proximal extent of the attachment of the *Mm. intercostales*. This crest is most likely just distal of the non-articular tubercle, the position at which proximal thickness and height are taken. Mild rugosity extends distally along the attachment area of the intercostal muscles and pleura.

RIB 3

Right: M.54027 (GC 86 8)

Left: M.54018 (GC 86 12)

The right third rib preserves most of the body (Fig. 12). This 167.5mm long fragment is intact from the posterior angle proximally to somewhere proximal of the anterior angle distally. The proximal break line on the external surface follows the *M. iliocostalis* line. There is some very slight weathering to the external surface of the shaft distal of the posterior angle, but otherwise the bone is well preserved. Some very fine cutmarks can be seen on the exterior surface of the shaft about 39mm distal of the intersection of the *M. iliocostalis* line with the inferior margin of the shaft. The right third rib has a slight irregularity to its distal shaft, perhaps representing a healed fracture. Most of the body of the left third rib is preserved, from the non-articular tubercle proximally (none of the articular facet is preserved) to somewhere proximal of the anterior angle (Fig. 12). None of the sternal chondral articular surface is preserved. Matrix still adheres to the broken proximal end. The total length of the specimen is 207.8mm. Scratch marks (perhaps cutmarks) are visible on the external surface of the shaft.

The *M. levator costae* attachments are visible in both ribs, although more of this region is preserved in the left rib. In the right side a portion of a small and very slight crest can be seen, while the left rib retains a distinct and rugose crest for the insertion of *M. levator costae* and the proximal intercostal muscles. What is preserved of the

M. iliocostalis line in the right rib is a clear but non-rugose scar. In the left rib, the *M. iliocostalis* scar is well defined, with distinct proximal and distal crests. The ribs are relatively thick mediolaterally with distinct, albeit shallow *Mm. intercostales* grooves along the superior edges. The ribs show some asymmetry in the development of the subcostal grooves. On the right side the subcostal sulcus is very poorly developed and cannot even be seen for most of the length of the specimen. In the left, the subcostal groove is large and well marked in the region of the posterior angle, with a well developed crest along the exterior surface of the inferior border.

RIB 4

Right: M.54028 (GC 86 7)

Left: M.54019 (GC 87 181)

The right fourth rib preserves most of the corpus (Fig. 12). The specimen has a total length of 182.0mm, and is complete from the very distal end of the tubercle proximally to somewhere proximal of the anterior angle. The shaft has some very slight weathering damage as well as a few small bits of adherent matrix distal of midshaft but otherwise is well preserved. Cutmarks can be seen on the superior margin of the external surface of the body proximal to mid-shaft. Most of the body of the left fourth rib is represented. The total length of this fragment is 158.3mm, and the bone is preserved proximally from just distal of the non-articular tubercle to somewhere proximal of the anterior angle distally. The specimen is badly weathered and partially eroded along its inferior half. Very fine cutmarks can be made out in two locations on the external surface near the distal break.

In both ribs, the *M. iliocostalis* lines and *M. levator costae* insertion areas are clearly evident, but are not rugose. The *M. iliocostalis* lines terminate as small inferiorly projecting flanges at their intersections with the inferior margins of both ribs. The subcostal sulci are wide and shallow, and both ribs are relatively thick mediolaterally.

RIB 5

Right: M.54029 (GC 87 163)

Left: M.54020 (GC 87 160)

Both fifth ribs are preserved (Fig. 12). The right fifth rib preserves most of the body. The fragment is 191.7mm long and is complete from the body between the tubercle and posterior angle proximally (the internal surface extends farther than the external and may include a portion of the shaft deep to the tubercle, and perhaps even part of the neck) to somewhere proximal of the anterior angle (again the internal surface extends farther and may end just at the anterior angle). The shaft has some weathering damage just distal of the posterior angle but is otherwise well preserved. Cutmarks can be seen on the superior margin of the external surface of the body at or just distal to mid-shaft. The left fifth rib is similarly represented. This rib fragment has a total length of 197.3mm and is preserved from the very distal-most point on the non-articular tubercle proximally to somewhere proximal of the anterior angle distally. The rib shows some slight weathering on its external surface and has a few spots of crushing, but overall is well preserved.

The left rib displays a moderate ridge in the region of the *M. levator costae* insertion. In both sides the *M. iliocostalis* lines are clearly marked but not rugose. In the right rib there is a large flange at the posterior angle where the *M. iliocostalis* line intersects the inferior border (this region is damaged in the left side rib). The bodies of both ribs are mediolaterally expanded and both sides have superoinferiorly wide subcostal grooves (in the region of midshaft, the right-side rib subcostal sulcus has an SI diameter of 4.6mm).

RIB 6

Left: M.54021 (GC 87 45)

Only the left sixth rib could be securely identified (Fig. 12). Two right side rib fragments (described below) could not be confidently identified as to number, and one or both of these may represent the right side sixth rib.

M.54021 preserves the body of left sixth rib, from just distal of the tubercle to below midshaft (but proximal of the anterior angle). The total length of this relatively well preserved specimen is 163.8mm.

The *M. iliocostalis* line begins as a tubercle on the superior edge of the rib, then runs obliquely to the posterior angle. The line is not very marked and is difficult to discern.

RIB 7

Left: M.54022 (GC 86 22)

Only the left seventh rib could be securely identified (Fig. 12). Two right side rib fragments (described below) could not be confidently identified as to number, and one or both of these may represent the right side seventh rib.

The left seventh rib is represented by a fragment that preserves the body from just distal of the tubercle to below midshaft (but proximal of the anterior angle). The total length of the fragment is 146.5mm. Cutmarks can be seen on the superior edge of the external surface near the middle of the preserved portion.

The scar for the *M. levator costae* is clearly defined and moderately rugose. The *M. iliocostalis* line is difficult to distinguish, but its point of intersection with the inferior edge of the rib is clear. The superoinferior diameter of the body proximal of the subcostal groove is small (10.4mm), but by the midshaft region the subcostal groove is large, giving the body a superoinferior diameter of 18.1mm.

INDETERMINATE RIBS 6-9

Right: M.54031 (GC 86 14)

M.54030 (GC 86 'Mr. Barrett's find' Skeleton Pit)

Left: M.54023 (GC 87 134)

M.54024 (GC 87 130)

M.54025 (GC 87 31)

M.54031 preserves the head, neck and tubercle of a right side typical rib. The total length of the fragment is 46.9mm. Damage to the proximal end obliterates the crest of the head, but it is clear that two articular facets were present. A neck length (see above) of ca. 29mm can be estimated from the preserved morphology. In posterior view, the articular tubercle can be seen to be directed inferiorly and the non-articular tubercle is positioned directly distally (on the inferior part of the external surface and rounding down on the inferior edge). The rib body has a superoinferior diameter (proximal height [M-1], Martin, 1928) of 11.5mm just distal of the tubercle.

An additional specimen, M.54030, is a 121.8mm long fragment of the anterior body of a right typical rib. This specimen appears to preserve the anterior angle. The distal end of the superior groove for the *M. intercostales* can be seen on the proximal end of the fragment. There is no subcostal groove in this element (even though the inferior edge of the rib is preserved), and no sternal chondral articular surface is preserved. The rib is large and the proximal end is mediolaterally thick.

A third fragment, M.54023, represents the mid-proximal portion of a left typical rib. The fragment is 65.7mm long and preserves the non-articular tubercle and most of the articular tubercle proximally, and is complete distally to the beginning of the posterior angle on the external surface and to just distal of the posterior angle on the internal surface. The shaft between the tubercle and angle is mediolaterally thick. The articular facet is preserved distally, is relatively flat, and is 8.0mm wide at its widest point (with a length > 9.5mm). The flat articular surface is consistent with a rib from the

series 7–9 (McMinn & Hutchings, 1985). What may be incipient marginal lipping is evident on the superodistal edge of the articular tubercle. There is a distinct sulcus between the articular and non-articular tubercles. Rugosity is visible on the superior surface in the area of the *Mm. intercostales* and *levator costae* attachment sites. The inferior margin has pronounced rugosities in the region of the insertion of the intercostal muscles, just distal of the tubercle. The proximal end of the subcostal groove is present, but the groove is damaged further distally. There is an oblique crest (running superproximal to inferodistal) on the external surface of the shaft 11.3mm distal of the non-articular tubercle (taken from the crest at the shaft superoinferior mid-point to the middle of the tubercle). This may represent a lateral extension of fibres from the *M. levator costae longus*, indicating that this represents a ninth rib.

A fourth fragment, M.54024, preserves 65.9mm of the body of a rib. The side is indeterminate. The external surface is damaged but preserves some scratches (perhaps cutmarks) on the external surface. Based on size and thickness, this fragment is likely to be from a typical rib belonging to Individual Two.

A fifth fragment, M.54025, preserves 71.9mm of rib body. The side is indeterminate. There is no indication of a subcostal groove, and therefore the fragment probably represents the anterior portion of one of the main ribs. The external surface bears a very slight rugosity which may represent the attachment area of the external oblique muscle at the anterior angle. In the region of the anterior angle, the rib body has a mediolateral diameter of 5.1mm and a superoinferior diameter of 16.1. Again based on size and thickness, this fragment is most probably associated with Individual Two.

RIB 10

Right: M.54032 (GC 87 147)

Only the right tenth rib is preserved (Fig. 12). This fragment includes 139.6mm of the body of the rib, from just distal of the non-articular tubercle proximally to somewhere between midshaft and the anterior angle distally. The entire surface is slightly weathered. What appear to be cutmarks can be seen on the external surface at the *M. iliocostalis* line.

The *M. iliocostalis* line in this rib is not rugose and is hardly visible (which may be a function of weathering). The insertion of the *M. levator costae* is clearly marked by a small tubercle and associated sulcus. A small tubercle on the inferior edge near the proximal break marks the insertion of the costotransverse ligament.

Individual 3

INDETERMINATE RIBS 4–9

Left: M.54033 (GC 89 021)

M.54034 (GC 87 24 & 10)

M.54035 (GC 87 268 & 180A & 61)

A third individual is represented by three left side ribs (Fig. 13). The first of these is M.54033, a 121.3mm long fragment of the body of a typical rib. The fragment is broken distal to the tubercle proximally and in the vicinity of midshaft distally. Based on the morphology of the body (torsion of the corpus and development of the subcostal groove) this appears to represent a rib from fairly high in the series.

Table 8 Dimensions (mm) of the ribs of Individual Three.

Rib	Prox. thick. ¹	Prox. height ²	Shaft thick ³	Shaft height ⁴
LIV?	(7.4) ⁵	(9.4) ⁵	8.9	–
LV?	7.8	8.5	7.8	14.4

1–4. See notes in Table 6

5 Position estimated.

Two fragments conjoin to form most of a left typical rib, M.54034. The total length of the complete rib is 163.5mm. The rib lacks only the articular surfaces of the head proximally, and is complete distally to somewhere proximal of the anterior angle. The entire bone is weathered and there are large cutmarks on the external surface at the distal end. The articular tubercle is relatively large in this specimen (11.5 mediolaterally by 8.0 proximodistally), but the non-articular tubercle is poorly developed. The *M. iliocostalis* line is poorly marked. Again, based on rib morphology this specimen appears to represent a rib from fairly high in the series, and may be the subjacent rib to M.54033.

Three additional fragments conjoin to form a 187.9mm long portion of another left typical rib, M.54035. The reconstructed rib is preserved from the region of the posterior angle proximally to somewhere proximal of the anterior angle. The fragment is uniformly weathered along its length, and the proximal end has some damage to it. The rib is thick mediolaterally (in the midshaft region, the mediolateral diameter of the rib = 9.2mm, the superoinferior diameter = 14.7mm). There is a very slight and moderately rugose sulcus visible on the superior edge for the attachment of the intercostal muscles. The subcostal groove is superoinferiorly broad yet shallow at the proximal end and tapers to nothing at the distal end. Based on the size and morphology of the rib, it is most likely one from the middle part of the series.

Additional rib fragments – unidentifiable as to side, number or individual

Ten rib fragments could not be securely identified as to individual, side (in most cases) or number. The first of these, M.54041 (GC 87 21, but not related to the right side twelfth rib of Individual One that bears the same excavation number), is a 67.2mm long fragment of the internal surface of a rib. A small portion of the superior surface of the subcostal groove is preserved for a length of about 32mm along one edge. Based on overall morphology this appears to be a portion of the body of a typical rib.

M.54036 includes two rib fragments. The first, GC 218A, is a 75.2mm long by 16.7mm high fragment of the external surface of a rib, side indeterminate. No landmarks are visible. The second, GC 218B, is a 51.0mm by 15.5mm fragment of the internal surface of a rib, side indeterminate, and with no visible landmarks. The specimen shows some weathering and surface damage.

M.54037 also includes two fragments, one of which is not a costal fragment. GC 87 134B is a 41.9mm long fragment of subperiosteal bone, likely representing a portion of the external surface of a rib. Some rugosity is evident along one edge, perhaps representing the *M. levator costae* insertion. GC 87 134C is a 62.6mm long fragment of diaphyseal bone. The cortex is 3.3mm thick on one edge and the internal surface is lightly trabeculated with coarse spicules.

M.54038 incorporates three fragments. GC 87 214A is a rib fragment with a total length of 52.1mm and a maximum width of 10.3mm. Only the internal surface is preserved. GC 87 214B is a 30mm long by 11.2mm wide (superoinferiorly) fragment of the external surface of a rib. This fragment also preserves a portion of either the inferior or superior edge. Two series of cutmarks can be seen on this specimen, the first of which are associated with a clean broken edge and likely represent excavation damage, the second consisting of four or more parallel marks, which may also be of recent origin. GC 87 214C measures 24.5mm by 6.5mm, and preserves a portion of the external surface and either the inferior or superior border of a rib.

M.54039 (GC 87 52) is a small fragment of a rib body concreted to a rock. No landmarks are evident on the external surface. The



Fig. 13 Ribs of individual 3, superior, $\times 0.9$.

fragment has a maximum length of 28.5mm and a maximum width of 12.7mm. One edge (either superior or inferior margin) is preserved on the side concreted to the rock.

Three small, non-diagnostic rib fragments were given museum designations M.54052 (incorporating two fragments, GC 87 117 A & B) and M.54040 (GC 87 246). In addition, GC 87 208 is the proximal half of a left rib which, because of a strong possibility that it may be non-human, was not given a museum designation. The articular surface of the head of this specimen is unfused and missing. The body below the tubercle is narrow superoinferiorly (7 to 8mm) out to the posterior angle, where the body flares to a superoinferior diameter of ca. 16mm. Just distal of the tubercle, the rib has a mediolateral diameter of 6.3mm and a superoinferior diameter of 7.8mm. The rib bears a round articular tubercle (10mm in diameter) but no non-articular tubercle. A shallow subcostal groove is present. There is no trace of the iliocostalis line at the posterior angle. At the posterior angle, the shaft has a mediolateral diameter of 5.7mm and a superoinferior diameter of 15.3mm. An abrasion (perhaps a cutmark) runs across the external surface distal of the posterior angle. Based on overall morphology (notably the SI flaring of the body distal of the posterior angle), if this rib does derive from a human, it may represent a 10th left side rib.

Morphology

Little can be added to a discussion of the morphology of the ribs to what has already been said above. It is clear that the ribs of Individual 1 derived from a relatively small person. The shaft dimensions of this individual's ribs are generally smaller than those of Individual 2 and the average values of a small sample of Euro-American males (Table 9). Given that vertebral remains described above also derived from a relatively small person, it is possible that they represent the same

Table 9 Rib shaft dimensions in the Gough's Cave Creswellian assemblage and recent European-American males (mean, SD)^a.

Rib		Individ. I	Individ. II	Individ. III	EuroAmericans (n=20)
3	Thickness	5.7 ^b	9.4	—	7.8 ± 1.1
	Height	10.0 ^b	13.9	—	11.2 ± 1.7
	T/H ratio	0.57 ^b	0.68	—	0.71 ± 0.1
4	Thickness	8.0 ^b	10.2	—	8.6 ± 0.9
	Height	8.9 ^b	13.9	—	11.7 ± 1.9
	T/H ratio	0.90 ^b	0.73	—	0.74 ± 0.1
5	Thickness	10.6 ^b	10.3	7.8 ^b	9.0 ± 1.0
	Height	6.1 ^b	15.7	14.4 ^b	12.8 ± 1.6
	T/H ratio	1.74 ^b	0.66	0.54 ^b	0.71 ± 0.1
6	Thickness	10.9	8.7 ^b	—	9.2 ± 1.0
	Height	9.1 ^b	18.8 ^b	—	13.9 ± 1.5
	T/H ratio	1.20 ^b	0.46 ^b	—	0.67 ± 0.1
7	Thickness	—	8.3 ^b	—	9.0 ± 1.0
	Height	—	18.2 ^b	—	15.0 ± 1.9
	T/H ratio	—	0.46 ^b	—	0.61 ± 0.1
10	Thickness	—	7.7	—	7.1 ± 1.2
	Height	—	15.6	—	15.6 ± 2.3
	T/H ratio	—	0.49	—	0.46 ± 0.1
11	Thickness	5.4	—	—	6.1 ± 1.0
	Height	11.2	—	—	12.9 ± 1.6
	T/H ratio	0.48	—	—	0.48 ± 0.1

^a Dimensions for Euro-American males are for right-side ribs and are taken from Franciscus & Churchill, in press.

^b Taken on left-side rib.

individual, likely a female. The ribs of Individual 1 are unusual in their great mediolateral thickness relative to their superoinferior height, at least as indicated by ribs four through six (Table 9). This results in midshaft thickness to height ratios that are between 1.6 and 10.3 standard deviations above the mean ratios in the Euro-American male comparative sample. This extreme mediolateral diameter

of the ribs gives them a rectangular shape in cross-section, and it was in fact this morphology (along with size differences) that allowed for the relatively easy sorting of the ribs of Individuals 1 and 2 (see above).

The second individual is the larger of the three, with rib midshaft dimensions that compare favorably with the mean Euro-American male values in size and shape (Table 9). Based on the comparisons in Table 9, Individual 2 most likely represents a male.

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